CLAIMS

What is claimed is:

1. An apparatus for engaging a work piece during an electrolytic process, the apparatus comprising:

a cup having an interior region and a lip within the interior region arranged such that the lip can support the work piece while the work piece remains within the interior region;

a first plurality of electrical contacts arranged about the lip for providing electrical current to the work piece via a metal layer thereon;

a second plurality of electrical contacts arranged about the lip for measuring electrical resistance through the metal layer on the work piece; and

a cone having a work piece contact surface that fits within the cup's interior and can contact the work piece in a manner that holds the work piece in a fixed position between the work piece contact surface and the lip;

wherein a first circuit contains the first plurality of electrical contacts and a second circuit, isolated from the first circuit, contains the second plurality of electrical contacts.

2. The apparatus of claim 1, wherein each contact of the first plurality of electrical contacts comprises a resistor.

3. The apparatus of claim 2, wherein the resistor is a thick-film resistor.

4. The apparatus of claim 3, wherein the thick-film resistor is made of a material comprising at least one of ruthenium oxide, platinum-silver, and palladium-silver.

5. The apparatus of claim 1, wherein the work piece is a semiconductor wafer.

6. The apparatus of claim 5, wherein the lip comprises a lip seal made from a material that provides a fluid-tight seal with the semiconductor wafer when the wafer is held in place by the cone.

7. The apparatus of claim 6, wherein the material is an elastomer comprising at least one of a silicone rubber, a fluoropolymer, a butyl rubber.

8. The apparatus of claim 7, wherein the elastomer comprises at least one of Chemraz, Tefzel, Sifel, Viton, and Kalrez.

9. The apparatus of claim 7, wherein each of the first and second plurality of electrical contacts makes electrical connection to the metal layer via one or more embedded contacts in the elastomer.

10. The apparatus of claim 9, wherein the one or more embedded contacts comprise at least one of Isocon, conductive polymers, wires, flat metal springs, ShinEtsu connectors, and z-conductive polymers.

11. The apparatus of claim 10, wherein the one or more embedded contacts comprise at least one of berylium-copper, gold-palladium, berylium-copper plated with gold-palladium, Paliney-7, platinum plated on stainless steel, rhodium plated on stainless steel, and rhodium.

12. The apparatus of claim 11, wherein the embedded contact comprises a wire.

13. The apparatus of claim 12, wherein the wire is between about .003 and .015 inches in diameter.

14. The apparatus of claim 1, wherein at least a portion of the cup comprises at least one of a plastic, a ceramic, a plastic-coated ceramic, a plastic-coated metal, a glass, a glass-coated metal, a glass-coated ceramic, a silicon-oxide coated ceramic, and a composite.

15. The apparatus of claim 14, wherein a plastic used in the coating of the plastic-coated ceramic or metal is a fluoropolymer.

16. The apparatus of claim 14, wherein the ceramic or a ceramic used in the plastic-coated ceramic is alumina or zirconia.

17. The apparatus of claim 9, wherein the width of the lip seal is between about 1 and 4mm wide.

18. The apparatus of claim 17, wherein the width of the lip seal is about 1mm wide.

19. The apparatus of claim 18, wherein lip seal contacts the metal layer on the wafer's outermost circumferential edge.

20. The apparatus of claim 5, wherein the metal layer is a copper seed layer.

21. The apparatus of claim 2, wherein the resistor has an electrical resistance of between about 1 and 20ohms.

22. The apparatus of claim 2, wherein the resistor has an electrical resistance of about 6ohm.

23. The apparatus of claim 1, wherein the first plurality of electrical contacts comprises between about 100 and 1000 electrical contacts.

24. The apparatus of claim 23, wherein the first plurality of electrical contacts comprises at least 128 electrical contacts for a 200mm wafer.

25. The apparatus of claim 23, wherein the first plurality of electrical contacts comprises at least 384 electrical contacts for a 300mm wafer.

26. The apparatus of claim 1, wherein the second plurality of electrical contacts comprises between about 2 and 16 electrical contacts.

27. The apparatus of claim 1, wherein the second plurality of electrical contacts comprises 4 electrical contacts.

28. The apparatus of claim 1, wherein each contact of the first plurality of electrical contacts has its own individually regulated current source.

29. The apparatus of claim 21, wherein the resistor is between about 2 and 50mm from the point where its associated electrical contact meets the metal layer.

30. The apparatus of claim 29, wherein the resistor is about 5mm from the point where its associated electrical contact meets the metal layer.

31. A method of electroplating a work piece having a seed layer on its plating surface, the method comprising:

(a) electroplating a metal onto the work piece's plating surface via a first circuit; and

(b) assessing the continuity of the seed layer using one or more resistance values obtained with a multi-point measurement via a second circuit;

wherein the first circuit is electrically isolated from the second circuit, and both the first and the second circuits are contained at least in part in a wafer holder of an electroplating apparatus.

32. The method of claim 31, wherein the work piece is a semiconductor wafer.

33. The method of claim 32, wherein the metal is copper.

34. The method of claim 32, further comprising controlling the uniformity of the deposited metal layer during electroplating by providing a plating current to the seed layer via a first plurality of electrical contacts, which are part of the first circuit, wherein the plating current is regulated based on the multi-point measurement, said multi-point measurement taken using a second plurality of electrical contacts, which are part of the second circuit.

35. The method of claim 34, wherein each of the first plurality of electrical contacts comprises an individually regulated current source.

36. The method of claim 34, wherein each of the first plurality of electrical contacts comprises a resistor.

37. The method of claim 36, wherein the resistor has an electrical resistance of between about 1 and 20ohms.

38. The method of claim 37, wherein the resistor has an electrical resistance of about 6ohms.

39. The method of claim 37, wherein the electroplating apparatus comprises:

a cup having an interior region and a lip within the interior region arranged such that the lip can support the wafer while the wafer remains within the interior region; and

a cone having a wafer contact surface that fits within the cup's interior and can contact the wafer in a manner that holds the wafer in a fixed position between the wafer contact surface and the lip;

wherein the first and second plurality of electrical contacts are arranged about the lip.

40. The method of claim 39, wherein the lip comprises a lip seal made from a material that provides a fluid-tight seal with the wafer when the wafer is held in place by the cone.

41. The method of claim 40, wherein the material is an elastomer comprising at least one of a silicone rubber, a fluoropolymer, a butyl rubber.

42. The method of claim 41, wherein the elastomer comprises at least one of Chemraz, Tefzel, Sifel, Viton, and Kalrez.

43. The method of claim 42, wherein each of the first and second plurality of electrical contacts makes electrical connection to the seed layer via one or more embedded contacts in the elastomer.

44. The method of claim 43, wherein the one or more embedded contacts comprise at least one of Isocon, conductive polymers, wires, flat metal springs, ShinEtsu connectors, and z-conductive polymers.

45. The method of claim 44, wherein the one or more embedded contacts comprise at least one of berylium-copper, gold-palladium, berylium-copper plated with gold-palladium, Paliney-7, platinum plated on stainless steel, rhodium plated on stainless steel, and rhodium.

46. The method of claim 45, wherein the embedded contact comprises a wire.

47. The method of claim 46, wherein the wire is between about .003 and .015 inches in diameter.

48. The method of claim 39, wherein at least a portion of the cup comprises at least one of a plastic, a ceramic, a plastic-coated ceramic, a plastic-coated metal, a glass, a glass-coated metal, a glass-coated ceramic, a silicon-oxide coated ceramic, and a composite.

49. The method of claim 48, wherein a plastic used in the coating of the plastic-coated ceramic or metal is a fluoropolymer.

50. The method of claim 48, wherein the ceramic or a ceramic used in the plastic-coated ceramic is alumina or zirconia.

51. The method of claim 43, wherein the width of the lip seal is between about 1 and 4mm wide.

52. The method of claim 51, wherein the width of the lip seal is about 1mm wide.

53. The method of claim 51, wherein lip seal contacts the seed layer on the wafer's outermost circumferential edge.

54. The method of claim 39, wherein the seed layer comprises copper.

55. The method of claim 34, wherein the first plurality of electrical contacts comprises between about 100 and 1000 electrical contacts.

56. The method of claim 55, wherein the first plurality of electrical contacts comprises at least 128 electrical contacts for a 200mm wafer.

57. The method of claim 55, wherein the first plurality of electrical contacts comprises at least 384 electrical contacts for a 300mm wafer.

58. The method of claim 34, wherein the second plurality of electrical contacts comprises between about 2 and 16 electrical contacts.

59. The method of claim 58, wherein the second plurality of electrical contacts comprises 4 electrical contacts.

60. The method of claim 37, wherein the resistor is between about 2 and 50mm from the point where its associated electrical contact meets the seed layer.

61. The method of claim 38, wherein the resistor is about 5mm from the point where its associated electrical contact meets the seed layer.

62. The method of claim 39, further comprising using at least one of the first and the second plurality of electrical contacts to detect the presence of a conductive fluid within a region of the cup that comprises the first and second plurality of electrical contacts.